WHAT IS CLAIMED IS:

1. A silicon carbide matrix composite material, comprising:

a silicon carbide matrix which comprises a first silicon carbide phase having silicon carbide crystal grains with an average crystal grain diameter in a range of 0.1 to 10 μm and a second silicon carbide phase having silicon carbide crystal grains with an average crystal grain diameter in a range of 0.01 to 2 μm; and

a silicon phase which is continuously present in network form in the interstices of the silicon carbide crystal grains constituting the silicon carbide matrix.

2. The silicon carbide matrix composite material according to claim 1, wherein the composite material contains the silicon phase in a range of 5 to 50 mass%.

3. The silicon carbide matrix composite material according to claim 1, wherein the silicon phase has an average diameter in a range of 0.03 to 3 μm.

4. The silicon carbide matrix composite material according to claim 1, wherein the intergranular area of the silicon carbide crystal grains constituting the silicon carbide matrix and the silicon phase is in a range of 0.1 to 10 m^2/g.

5. The silicon carbide matrix composite material according to claim 1, wherein the first silicon carbide phase comprises silicon carbide blended as aggregate, the second silicon carbide phase comprises silicon carbide produced by a reaction of carbon and silicon, and the first silicon carbide phase has an average crystal grain diameter larger than that of the second silicon carbide phase.

6. The silicon carbide matrix composite material according to claim 1, wherein the first silicon carbide phase comprises an α phase or a β phase, the second silicon carbide phase comprises a β phase, and the first silicon carbide phase has an average crystal grain diameter larger than that of the second silicon carbide phase.

7. The silicon carbide matrix composite material according to claim 1, wherein the silicon carbide matrix composite material has a bending strength of 500 MPa or more.

8. A process for producing a silicon carbide matrix composite material, comprising:

press forming a mixed powder of silicon carbide powder having an average grain diameter in a range of 0.1 to 10 μm and carbon powder having an average grain diameter in a range of 0.005 to 1 μm into a compact having a desired shape; and

impregnating molten silicon into the compact while heating the compact to a temperature of the melting point or more of the silicon.

9. The process for producing a silicon carbide matrix composite material according to claim 8, wherein the silicon carbide powder and the carbon powder are mixed at a mass ratio in a range of 10:1 to 10:10.

10. The process for producing a silicon carbide matrix composite material according to claim 8, wherein:

the silicon impregnation step forms a silicon carbide matrix which comprises a first silicon carbide phase formed of the silicon carbide powder and having silicon carbide crystal grains with an average crystal grain diameter in a range of 0.1 to 10 μm and a second silicon carbide phase formed by a reaction of the silicon

carbide powder and the silicon and having silicon carbide crystal grains with an average crystal grain diameter in a range of 0.01 to 2 μm and also causes the silicon phase to continuously present in network form in interstices of the silicon carbide crystal grains constituting the silicon carbide matrix.

11. The process for producing a silicon carbide matrix composite material according to claim 10, wherein the silicon phase is present in a range of 5 to 50 mass% in the composite material.

12. The process for producing a silicon carbide matrix composite material according to claim 8, wherein the forming step casts slurry containing the mixed powder under a pressure of 0.5 to 10 MPa.

13. The process for producing a silicon carbide matrix composite material according to claim 8, wherein the forming step press forms the mixed powder under a pressure of 0.5 to 2 MPa.

14. The process for producing a silicon carbide matrix composite material according to claim 8, wherein the silicon impregnation step impregnates the molten silicon into the compact heated to 1400°C or more under reduced pressure or in an inert atmosphere.

15. A process for producing a part of a silicon carbide matrix composite material, comprising:

forming a mixed powder of silicon carbide powder having an average grain diameter in a range of 0.1 to 10 μm and carbon powder having an average grain diameter in a range of 0.005 to 1 μm into a compact having a desired shape;

producing a sintered body of a silicon carbide matrix composite material by heating the compact to a temperature of the

melting point or more of silicon and also impregnating molten silicon into the compact; and

fabricating the surface of the sintered body to provide a part having the final size.

16. **(Amended)** A process for producing a part of a silicon carbide matrix composite material, comprising:

forming a mixed powder of silicon carbide powder **having an average grain diameter in a range of 0.1 to 10 μm** and carbon powder **having an average grain diameter in a range of 0.005 to 1 μm** into a preliminary compact having a size larger than the final size;

processing at least a part of the preliminary compact into a compact having a size smaller than that of the preliminary compact but larger than the final size;

producing a sintered body of the silicon carbide matrix composite material by heating the compact to a temperature of the melting point or more of silicon and also impregnating molten silicon into the compact; and

fabricating the surface of the sintered body to provide a part having the final size.

17. The process for producing a part of a silicon carbide matrix composite material according to claim 16, wherein the compact is produced to be larger than the final size by a range of 10% or less.

18. The process for producing a part of a silicon carbide matrix composite material according to claim 16, wherein the compact is produced to be larger than the final size by a range of 5% or less when the compact has a size exceeding 200 mm.

19. A process for producing a part of a silicon carbide

matrix composite material by bonding plural part units formed of

a silicon carbide matrix composite material, comprising:

forming a mixed powder of silicon carbide powder and carbon powder into a desired shape to produce plural compacts corresponding to the plural part units;

adhering the plural compacts by an organic adhesive; and

impregnating molten silicon into the plural compacts including the bonded portion by the organic adhesive, reaction sintering the plural compacts to provide the plural part units and integrally bonding the plural part units by the reaction produced silicon carbide and the silicon present in network form.

20. The process for producing a part of a silicon carbide matrix composite material according to claim 19, wherein the plural compacts are bonded and subjected to a heat treatment to change the bonded portion by the organic adhesive to a porous body.

21. A process for producing a part of a silicon carbide matrix composite material by bonding plural part units formed of the silicon carbide matrix composite material, comprising:

removing silicon which is present on the bonding surfaces of the plural part units formed of the silicon carbide matrix composite material;

adhering the bonding surfaces of the plural part units by an organic adhesive; and

impregnating molten silicon into the bonded portion by the organic adhesive and integrally bonding the plural part units by the reaction produced silicon carbide and the silicon present in network form.

22. The process for producing a part of a silicon carbide matrix composite material according to claim 21, wherein the plural

part units are adhered and undergone a heat treatment to change the bonded portion by the organic adhesive to a porous body.